

SCIENCE FOR GLASS PRODUCTION

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GLASS PRODUCTION IN RUSSIA — ANALYSIS AND FORECAST

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The general state of the glass industry in Russia at the present stage is analyzed. It is shown that on the basis of the production volume of sheet glass and glass containerware the glass industry is one of the largest industrial sectors in Russia. An intermediate-term forecast of the demand for the main resources — gas, electricity, sand, dolomite, soda, and cullet — is constructed on the basis of a determination of the trends in the further growth of glass production in Russia.

The market for glass and glass articles is now one of the most rapidly developing and promising markets. The production capacity for glass products is growing every year. Today, when all types of resources are becoming increasingly more expensive, price competition is occurring on the world market. This is precisely why one of the main problems facing manufacturers is lowering the costs per unit of production as much as possible as compared with worldwide competitors while providing high quality.

An intermediate-term forecast of the demand for the basic resources (gas, electricity, sand, dolomite, soda, and others) based on an analysis of glass production is needed, the main trends in the glass production volume in Russia must be determined, and the level of future costs for glass founding in connection with a change in the tariffs and price policies and ways to reduce these costs must also be found.

Glass technology and the glass industry as a whole are characterized by the following positive features:

- diversity of compositions and a wide range of material properties;
- technological possibilities for fabricating glass articles different shapes and sizes;
- extensive and accessible raw materials base;
- acceptable energy-intensiveness of the technological processes;
- adequate ecological safety of the industrial production processes.

These features determine the place which glass materials and glass articles occupy in modern materials engineering and industrial production. The total production of glass in the world at the present time is about 100 million metric tons per year, and the cost of the glass articles produced is estimated to be €105 billion.

The glass industries throughout the world and in Russia are based on large-tonnage production of, first and foremost, sheet and container glass. In these sectors of the Russian glass industry, growth has been stable in the last few years, following a period during the 1990s when growth decreased as a result of the general crisis of industrial production in the country due to the global socioeconomic changes taking place in Russia. The negative phenomena of that period were very strikingly manifested in the glass industry. Not only small and medium size enterprises but also very large companies in the industry declined. Some forms of production, for example, the production of electrovacuum glass, simply ceased to exist. In other forms of production, the number of workers and the production volumes decreased sharply.

Nonetheless, by the end of the 1990s and beginning of the new millennium, a rising trend appeared in the industry, first and foremost, in the production of glass containerware and later structural glass also (see Table 1); this trend is continuing now. The quantitative growth in the production of these types of glass and the increase in their quality are due to the substantial increase in the packaging of food products in glass containers, increase in the volumes of home and industrial construction, and a sharp increase in the demand for high quality in glass production. The transition of the glass

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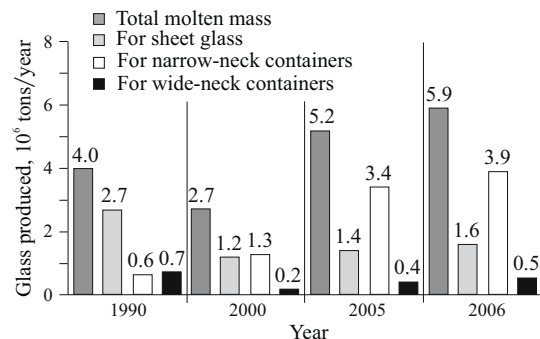


Fig. 1. Yearly production of glass from 1990 to 2006.

sector to a new level is based on the following intercoupled processes:

- flow of domestic and foreign capital into the sector;
- growth of operating and construction of new high-capacity enterprises;
- intense technical re-equipping of enterprises, providing these enterprises with modern glass forming equipment, high-quality refractories, and monitoring and measurement systems.

Considering the extensive Russian market and its attractiveness for investment, the stocks of many glass companies have been purchased by foreign companies (Bor glass plant, Russian-American glass company RASKO, and others). This enabled the enterprises to begin large-scale technical re-equipment of production, including the construction of large high-efficiency glassmaking furnaces and the acquisition of imported equipment. Correspondingly, this made it possible to increase the production of glass (Fig. 1) and to increase the production volume and quality.

A number of new glass factories have now been built, including by foreign companies (Glaverbel, Pilkington, Sise-cam), reconstruction has been completed, and many operating enterprises (RASKO, Veda-Pak, Stekloholding, Ost-Tara, Klin-steklotara, 9 Yanvar' Glass Works, Kamyshin Glassware Works, Kavminsteklo, and others) have put new glass process lines into operation. These enterprises are equipped with modern glassmaking furnaces and glass-forming machines at the European level, and they are equipped with high-precision monitoring and measurement equipment and modern packing lines. Most of the process equipment is foreign-made.

TABLE 1.

Production	1990	2000	2005
Sheet glass, 10 ⁶ m ²	213.7	101.4	115.0
Containerware, 10 ⁶ :			
narrow-neck	1350.0	3001.5	8160.0
wide-neck	2400.0	773.0	1500.0

The main competition between the glass factories is now unfolding precisely in the sphere of the heat-engineering and glass-forming equipment used, which can provide high production capacity and product quality, and the use of complicated nonstandard and exclusive orders, especially in the production of glass containers.

More than 60% of the glass articles produced consist of glass containers. Glass containers are now produced in large Russian glass enterprises with annual capacity of up to 300 million containers or more as well as in small regional plants with capacity 50 – 70 million containers, which supply containers to nearby food and nonfood product producers. There are now more than 50 large and comparatively large plants producing glass containers. Most glass container plants are concentrated in the Central (more than 50%) and Southern (about 20%) regions. Most plants are located in Moscow, Vladimir, and Tver' Oblasts.

Since 2000 and the production of glass containers in Russia has been "explosive" (see Fig. 1). For example, in 2001 – 2004 the production volume of glass articles of this type increased by 4 billion containers in the 0.5-liter equivalent, or by almost a factor of 2. Most of the growth has been achieved as result of an increase in the production of narrow-neck glass containers for nonalcoholic and alcoholic beverages. The production of glass containers has now reached the 10 billion per year mark in the 0.5-liter equivalent.

The entry into the Russian market of large producers of glass containers (Rusdzhama, RASKO, Veda-Pak, and others) has made it possible to meet approximately 85% of the internal demand for this product, first and foremost, for "standard" bottles for ordinary products. The rest of the demand, first and foremost, for exclusive and nonstandard bottles, is satisfied by imports (the main importers are Poland, Finland, and other countries).

The current production of sheet glass in the entire world is oriented toward the float technology, which gives a high-quality product and high production capacity of the process lines. In Russia, sheet glass is produced by this technology in the Salavat, Bor, and Saratov plants. The first foreign companies to manufacture sheet glass in Russia were the firms Glaverbel and Pilkington with nominal capacities $(220 - 240) \times 10^3$ tons of glass per year (600 – 650 tons/day). These companies increased the production of sheet glass in Russia by approximately 30% (2004 – 2005). In 2000 – 2006 the amount of the molten glass produced for sheet glass increased from 1.2 to 1.6 million metric tons (see Fig. 1).

At the present time, several projects are being planned in Russia to build new float lines, and many of these lines are to be built with the participation of foreign investors (in the North-West region — Severo-Zapadnaya Glass Company with Chinese investments, in Ryazan' — Gardian Industries, in Stavropol'skii krai — YugRosProdukt JSC with French participation, and others). In the opinion of some analysts, when these projects are successfully completed, in two or

three years, foreign producers could be producing up to 30–35% of the sheet glass produced in Russia.

A characteristic feature of the present stage in the production of sheet glass in Russia is the appearance of a subsector for commercial reworking of the glass, which was essentially absent in our country very recently. This subsector produces solar-protective, heat-reflecting, and low-emission energy-conserving coated glasses, glass with strengthening, protective, and decorative polymer coatings, laminated, tempered, explosion- and fire-resistant, and bulletproof glass, and glass packets. At the present time, in Russia, only about 100 enterprises produce tempered glass, more than 500 enterprises produce multiplayer glass, and about 1000 enterprises produce glass packets. The increasing demand for glass particles of these types makes a large contribution to the total dynamics of sheet-glass production in Russia.

On the whole, the following indicators illustrate the general state of the domestic glass industry: the yearly increase of commercial production in Russia is on the average 7% in the last few years, while the increase in the production of the glass industry reaches 20–21% (glass containers). According to this indicator, the glass industry is one of the largest industries in Russia. The situation in the glass industry is manifested objectively in the dynamics of the growth in the amount of molten glass produced by glass producers in Russia (Fig. 2). In 2000 2.7 million metric tons of molten glass were produced for the production of sheet glass and glass containers, and by 2006 up to 5.9 million metric tons were produced.

The volumes of the commercial production of glass are always closely linked with growth in construction, transportation, and production of food, chemical, and pharmaceutical products. Consequently, the forecast of growth of the glass industry is based on the growth dynamics of the use of glass articles in these sectors.

The construction sector in Russia, which is the main consumer of sheet glass (more than 60%), will require in the near and medium terms a substantial amount of high-quality glass and the products of commercial reprocessing of glass. The positive dynamics of glass use in this sphere is due to, on the one hand, an expansion of construction, primarily homes, and an increase in the glazed areas in modern buildings and structures (up to 85%) and, on the other hand, the need to replace glass (“old” windows) in existing buildings in order to decrease their heat losses. The yearly growth in the demand of glass in the construction industry (glass packets, flat, laminated, and multilayered glass) exceeds 10%. Correspondingly, this demand will be satisfied by an increase in the production of sheet glass. Thus, the prediction for the amount of molten glass mass required for the manufacture of sheet glass is 3.1 million metric tons in 2010, i.e., it will more than double over a period of five years (from 2000); see Fig. 2.

The production of beverages in Russia is one of the most dynamically growing sectors, where the rates of growth average 15–25% per year. Analysts believe that production will

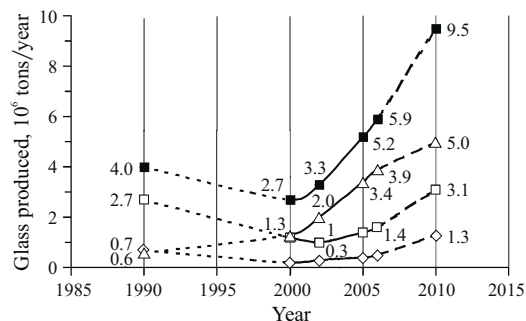


Fig. 2. Dynamics and forecast of molten glass production: ■) total molten glass mass; □) for sheet glass; △ and ◇) for narrow- and wide-neck containers.

continue to grow in this sector. Correspondingly, the demand for glass containers will also remain. In addition, there are two other circumstances which promote an increase in the production volume of glass containers:

even though there is stiff pressure from producers of plastic and metal containers, these types of containers will be gradually be replaced by ecologically safer glass containers; an inevitable limit on the use of recycled glass containers.

These factors taken together produce a positive dynamics for the production volume of glass containers but not in the same degree as 2000–2005; this is mainly due to definite saturation of the glass container market in recent years. In addition, large producers of beverages, who are dissatisfied with the quality of the bottles produced domestically and the cost of imported products, can provide competition for purely glass products. They see the solution to the problem in the organization of domestic glass container production. An example of this approach is the OST Company which produces alcoholic and nonalcoholic beverages. In 2000 this company put into operation a domestic glass container plant with nominal capacity 260 million containers to satisfy its own demand for high quality and, at the same time, sufficiently cheap glass containers.

The amounts of molten glass which is predicted for the production of narrow-neck glass containers by 2010 increases by somewhat more than 1 million metric tons, i.e., its rate of growth will be lower than that of the production of sheet glass and for the industry as a whole (see Fig. 2).

Aside from the salient features examined above, a small decrease in the rate of production of molten glass for articles of this kind will be due to the transition of enterprises to the production of lighter bottles. The narrow-neck press blowing (NNPB) technology used by Western and some Russian manufacturers (Klin-steklotara, Salavatsteklo, Bun'kovskii experimental plant, and others) makes it possible to decrease the mass of a unit of production by up to 30% (for bottles with capacities 0.5 liters — on the average from 380–390 to 270–290 g). The molten glass mass savings for the manufacturing of, for example, one billion light articles in the 0.5-liter equivalent will exceed 100000 metric tons.

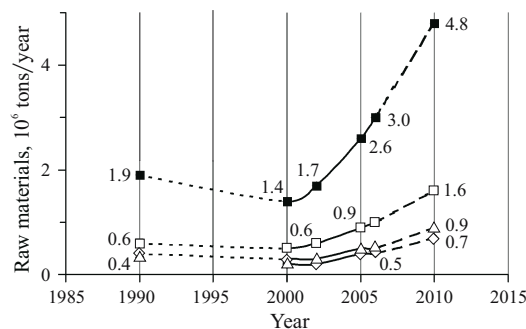


Fig. 3. Dynamics of the consumption of raw materials in the glass industry: ■) sand; □) soda; △) dolomite; ◇) chalk.

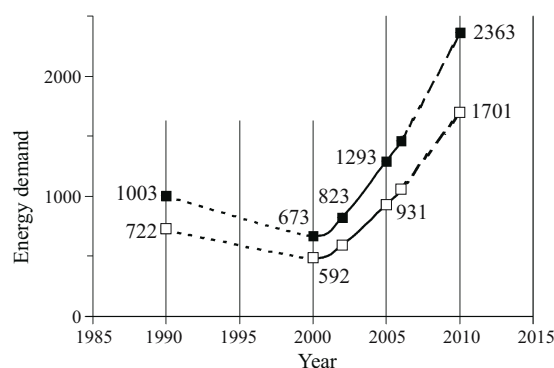


Fig. 4. Dynamics of the consumption of energy resources in the glass industry: ■) gas, 10⁶ m³/year; □) electricity, 10⁶ kW/year.

The forecasted growth of the glass industry raises the problem of providing the material and energy resources for it. Since 2000 the amount of the main raw materials — sand, dolomite, chalk, soda — required by the glass industry has almost doubled (Fig. 3). Evidently, the demand for raw materials will also increase with an increase in the quantity of molten glass founded.

Russia possesses large reserves of nonmineral natural resources used in making glass. However, the problem now lies in the qualitative level of this raw material — its suitability for production of high-quality molten glass. Natural raw materials must meet the requirements for the content of the main substance and coloring impurities, constancy of chemical composition, and granulometry. For example, in the production of colorless glass, sand and dolomite must meet more stringent requirements with respect to be content of iron oxides, which give glass an undesirable color hue. This is because the glass container has become an integral part of the brand name and the brands of many beverage producers, so that a great deal of attention is given to the design of such containers. It is sufficient to state that the producers of expensive elite beverages use well-known design studios and even popular clothes designers to develop the packaging design. The quality of such glass production must be impeccable

with respect to geometric parameters and color. A number of middle-level beverage producers, especially foreign companies, also have their own standards and normative documents, which are more stringent than the domestic ones, for glass containerware and require that the production acquired meet these norms.

The problem of providing calcined soda to glass factories is now very acute. This is due to, first and foremost, the pricing policies of the producers of this chemical component of glass batches. The sharp increase in the price of soda has led to a substantial increase in the cost of producing molten glass. In analyzing future development of this situation, it is also necessary to take account of plans of some soda producers to develop their own glass production.

About 8% of all fuel consumed in industry is used in glass production. The average energy-content of glass making at a substantial number of enterprises is 50 – 100% higher than that achieved in Europe.

Since 2000 the quantity of energy resources (gas, electricity) used in the production of glass has almost doubled (Fig. 4). Evidently, the demand for gas and electricity will grow even more in accordance with the increase in the amount of molten glass produced.

To decrease the production cost of molten glass by 2010, the consumption of energy in glass production must be decreased. This is because the prices of energy carriers will increase, specially by 2010, and quotas will be set on the consumption of natural gas.

The need to increase the efficiency of the utilization of resources and energy is determined by micro- and macroeconomic factors and the effect on climate and environment. Today, the government does not stimulate improvement of energy efficiency in industry, and action must be taken at the level of industrial sectors and individual enterprises.

Great difficulties also arise in providing cullet to the glass industry. It is well-known that this is a very valuable material, whose use will make it possible to decrease the energy consumed to produce molten glass and to increase the quality of molten glass. For example, when the fraction of cullet in a glass batch is increased by 10%, the energy consumption for glass founding decreases by 2 – 3% (the specific decrease of energy consumption with the introduction of 1 ton of cullet is greater than 1200 MJ). European glass manufacturers use up to 40% cullet, and in some cases even more, in glass founding. In Russia the difficulties of supplying cullet to glass manufacturers are due to the virtual absence of a system for collecting and preparing secondary scrap, and the amount of scrap produced by the enterprises themselves cannot satisfy their own requirements. As a result, a number of glass manufacturers have been forced to decrease the amount of cullet used to 20%. Without a radical change in the collection of glass scrap the disbalance between the demand for and the supply of cullet will increase.

In summary, at the present stage there are good prospects for growth of large-tonnage glass production — sheet and

container glass, especially in the production of high-quality glasses, including products of commercial reprocessing of sheet glass and the production of nonstandard and exclusive glass containers. The trends of increasing demand for glass products will remain in place but to a lesser extent for glass containers than up to now. This is due to the new glass container factories put into operation and higher capacity of operating factories and, as a consequence, the rapid growth in the production of glass containerware in recent years.

The volume of molten-glass production in recent years has reached a high level and will increase in the future. This

will require using additional resources — raw materials, natural gas, and electricity. The main problems which have already appeared are due to the increase in the prices and tariffs on raw materials, primarily calcined soda, cullet, and energy carriers. Since glass production has increased, these problems can be substantially exacerbated in the future. The solution of these problems lies in increased production of conditioned mineral raw materials, optimizing the cost of material resources and energy carriers, and organizing a system for collecting glass scrap and preparing it for founding glass.